He was deeply interested in the establishment of the New York Botanical Garden, and many of his photographic studies were made from plants obtained there. Since the establishment of the Garden lecture courses, in the spring and autumn, the beauty of his lantern slides has been frequently admired by audiences assembled at the Museum Building, and his lectures have been among the most successful of any there delivered. He has followed the development of the Garden very closely, and since 1901 has been officially connected with it as honorary floral photographer. In addition to the organizations named above, he was a member of the New York Academy of Sciences, the American Association for the Advancement of Science, the American Museum of Natural History, the Brooklyn Institute, the American Forestry Association, the New York Horticultural Society, the American Geographical Society, the Union League Club, and the Holland Society. He was of a genial and kindly temperament, a delightful companion, full of information on all scientific topics, and his loss is deeply felt by all who have been favored with his acquaintance. His work, and that of his faithful and devoted wife, are commemorated in the beautiful *Polemonium Van Bruntiae*, which grows in the Catskill region which he loved so well, and where he spent a portion of each year. Mr. Van Brunt leaves no descendants.

EXPLOSIVE DISCHARGE OF ANTHEROZOIDS IN HEPATICAE

By F. Cavers, F.L.S.

In a recent number of *Torreya* (April, 1903), there appeared an interesting note by Dr. Cyrus A. King on the explosive discharge of antherozoids in *Conocephalum conicum* (*Fegatella conica*), in which reference was made to previously published accounts of a similar phenomenon in *Asterella Californica* by Dr. Peirce and in *Conocephalum* by the present writer. At the time of writing the note which appeared in the *Annals of Botany*, January, 1903, I was not aware of any previous accounts of such discharges,

which are not mentioned in Goebel's *Organographic der Pflanzen* or in other works on Bryophyta to which I had access. It appears, however, that the violent discharge of antherozoids in *Conocephalum* was described in 1856 by the late M. Thuret.* M. Ed. Bornet, who kindly wrote informing me of this observation of Thuret's, makes a reference to it in his "Notice biographique sur G. A. Thuret," † and it is also mentioned by M. Le Jolis in "Remarques sur la nomenclature hepaticologique," 1894, p. 130.

It has of course been long known that when the ripe antheridium of a liverwort or a moss takes up water, the mass of antherozoids becomes swollen and bursts through the antheridium-wall. In various mosses, the antheridium ends above in a well-marked cap ("Oeffnungskappe" of Goebel ‡), consisting of a single cell (*e. g.*, *Funaria*) or a group of cells (*e. g.*, *Polytrichum*). The cells of this cap become mucilaginous and on absorbing water are disorganized, leaving an opening through which the antherozoid-mass escapes. The existence of this cap and the manner in which the antheridial contents escape are indicated in Hedwig's descriptions and figures of moss-antheridia in his "Theoria generationis," 1784. For full details and figures, reference may be made to the descriptions of Goebel § and of Schaar.|| In *Sphagnum* and the majority of the Jungermanniaceae, the antheridium is usually spherical and there is, as a rule, no apical cap, but the mode of dehiscence is essentially the same; the cells forming the upper part of the antheridium-wall become mucilaginous and absorb water, either becoming detached or cohering to form valves which curve outwards. In *Frullania*, the apex of the antheridium is occupied by a radiating series of cells which are considerably longer than those forming the rest of the wall. The writer has observed that these elongated cap-cells become

* Mém. Soc. Sci. Nat. Cherbourg, 4: 216.

† Ann. Sci. Nat. Bot. V. 2: 336. 1875.

‡ Organographie, 238.

§ Organographie, 239; also "Ueber den Oeffnungsmechanismus der Moosantheridien." Suppl. Ann. Jard. Bot. Buitenzorg, 1898.

|| "Ueber den Bau und die Art der Entleerung der reifen Antheridien bei *Polytrichum*." Ber. Deutsch. Bot. Ges. 15: 479. 1897.

gelatinized and swell up on the addition of water, at the same time curving outwards and leaving a wide opening for the escape of the swollen mass of slime in which the antherozoids are embedded. During this year I have also had under observation a number of forms in which the antheridia are developed in cavities scattered singly along the surface of the thallus, namely *Riccia glauca*, *Pellia epiphylla*, *P. calycina*, *Aneura latifrons*, and *Pallavicinia Flotowiana*. In these forms, as in the mosses and the acrogynous Jungermanniaceae, the antherozoids were found to be discharged quietly, the slime containing them simply oozing out of the antheridial cavities. Several times in watching under the microscope living male plants of *Riella Capensis*, a mass of antherozoid-slime was seen to be suddenly expelled from the opening of an antheridial cavity on the free margin of the thallus-wing, but the force of the discharge did not send the mass to any appreciable distance (only about 2 millimeters) from the opening.

In the majority of the Marchantiaceae, the antheridia are developed in groups on specialized portions of the gametophyte, forming sessile or stalked receptacles, in the tissue of which the antheridia are more or less deeply sunk; each antheridium usually occupies a separate cavity, which communicates with a pore on the outer surface of the receptacle by a long narrow canal. Water is absorbed by (1) the cells of the tissue between the antheridia, (2) the cells forming the antheridial walls, and (3) the antherozoid-mother-cells, all of these cells having become mucilaginous. From renewed observations made this summer on male plants of *Conocephalum*, I can fully confirm the conclusion arrived at by Peirce and by King, namely, that the explosive discharge of the antherozoids from the antheridial cavity as jets of spray is to be attributed simply to this absorption of water by the cells of the antheridium itself and those of the surrounding tissue. It occurred to me to ascertain whether discharges could be induced in the case of dead plants. Male plants with well-developed receptacles were placed in absolute alcohol, in which they were allowed to remain for periods varying from a few hours to several days. They were then taken out and the receptacles moistened with water by means of a camel-hair brush. In

several cases, after a few applications of water in this way, jets consisting of the disorganized antheridial contents were observed to issue from the surface of the receptacle. With cold water, the jets were rather feeble, reaching a height of about a centimeter, but when warm water was used, jets were in several cases noticed which rose to heights of 3 to 5 cm., *i. e.*, nearly as high as in the case of living plants. This seems to afford conclusive proof that the mechanism by which these discharges are produced is simply pressure due to the swelling of gelatinized cells (or cell walls) on absorption of water; that the phenomenon is a mechanical and not a vital one. The presence of green assimilating tissue, with air-chambers and pores, in the upper portion of the receptacle, is probably to be regarded as enabling the receptacle to supply part, at least, of the plastic materials necessary in the development of the antheridia. This green tissue can hardly be now considered as playing the part in producing the discharges, by setting up an active transpiration current leading to the accumulation of water in the lower portion of the receptacle, which I was at first inclined to attribute to it. In living plants, I have found the discharges to be quite as active when the plants were placed in darkness, with slides fixed at distances of from 3 to 10 cm. above the receptacles, as in full sunlight. In my previous observations, the plants were supplied only occasionally with water, which was simply poured down the sides of the vessels in which they were growing, and the height to which the jets of antherozoid-containing spray rose was only from 3 to 6 cm. When plants were better supplied witn water, especially when this was poured or sprayed over the receptacles, the jets reached a height of 10 or 12 cm. in many cases.

I have this year observed similar, though less vigorous, discharges in three other Marchantiaceous forms, *Reboulia hemispherica*, *Preissia commutata*, and *Marchantia polymorpha*. In most cases the antheridial contents were ejected with little force, simply oozing out of the pores on the surface of the male receptacle as drops of whitish slime, but occasionally, in all three plants, well-marked jets were sent up. In *Reboulia*, these jets frequently reached about 5 cm., but in *Preissia* and *Marchantia* none were observed over 2 cm.

It may be remarked that in many localities where the writer has collected *Reboulia hemispherica*, the plants were found to be nearly all dioicous, the male and female plants frequently occurring in large patches consisting only of male or female plants and separated from each other by distances varying from a few inches to a foot or more. Most European writers state that this species is either monoicous or dioicous, but in the only detailed American description which I have at hand, that given by Dr. Howe in his "Hepaticae and Anthocerotes of California" (p. 40), it is said to be monoicous. Lett, in his "Hepatics of the British Islands" (1902) states that the male receptacles occur "mostly on separate plants" (p. 16).

TECHNICAL SCHOOLS, PLYMOUTH, ENGLAND.

A KEY TO THE NORTH AMERICAN SPECIES OF INOCYBE—II *

BY F. S. EARLE

Section RIMOSAE

1.	Spores smooth.	2.
	Spores rough—angular, tuberculate, or spiny.	10.
2.	Lamellae adnate or with a decurrent tooth.	3.
	Lamellae adnexed or nearly free.	7.
3.	Stipe with reddish fibrils.	*I. subroindica* Bann. & Pk. †
	Stipe glabrous or, if fibrillate, the fibrils not reddish.	4.
4.	Pileus brown with no tinge of red.	5.
	Pileus rufescent or cervinous.	6.
5.	Pileus 4–6 cm.; lamellae brown; stipe brown below.	*I. brunnescens* Earle
	Pileus 2–3 cm.; lamellae pallid; stipe white.	*I. pallidipes* El. & Ev.
6.	Pileus silky-shining, rimose; stipe pallid.	*I. eutheles* (B. & Br.) Quelet
	Pileus fibrillose, becoming lacerate; stipe reddish.	*I. destricta* (Fr.) Gillet
7.	Pileus 4–6 cm., pale ochraceous; stipe glabrous below, subbulbous.	*I. rimosa* (Bull.) Gillet
	Pileus 1–3 cm.; stipe fibrillose, equal.	8.
8.	Lamellae at first violaceous.	*I. violaceifolia* Peck
	Lamellae at first pallid or whitish.	9.
9.	Spores 8–10 $\mu \times 6\,\mu$, unequally elliptical; stipe white fibrillose throughout.	*I. euthelioides* Peck

* Continued from page 170.

† The name is printed *rubro-indica* by Saccardo, Syll. 11 : 52.